* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the manufacture method of the surface emission-type laser which is the light emitting device for the light sources used for optical communication or optical information processing.
[0002]
[Description of the Prior Art] In the surface emission-type laser of structure which forms high resistance partially by oxidization and performs the constriction of the inrush current to a barrier layer, AlXGa1-XAs of AlAs or high aluminum composition established near the barrier layer was conventionally made into the oxidizing zone, oxidation reaction of this oxidizing zone was advanced from the longitudinal direction from the circumference of a multilayer, and the method of carrying out the constriction of the inrush current alternatively was taken.
[0003] This structure and method are for example, photograph NIKUSU. Technology Letters It is carried on VOL.8,971-973 page (1996). This structure is shown in drawing 5 . In this conventional example, this oxidizing zone 5 is formed directly under the upper top multilayer reflecting mirror 6 of a barrier layer 3, using AlAs as an oxidizing zone 5. Oxidization of the oxidization tub 5 for forming current constriction structure advances oxidation reaction from the side of the multilayer exposed by etching, and is controlling the oxidization field by acting as the monitor of the near-field pattern of spontaneous-emission light. The time which oxidation reaction is advanced and oxidization from the side to a depth of 16 micrometers takes is 15 minutes by making substrate temperature into 400 degrees C in the nitrogen-gas-atmosphere mind containing a steam.
[0004]
[Problem(s) to be Solved by the Invention] However, by the method by the above-mentioned conventional example, it had the problem described below. That is, since it is necessary to advance oxidation reaction from the side of a multilayer, time to oxidize 10 micrometers of numbers from 10 micrometers generally is required, and it is difficult to control the non-oxidizing field used as a luminescence field by mum order. By the method of controlling especially in oxidation-treatment time, highly precise control of a steam and substrate temperature is needed, and it is very difficult.
[0005] Moreover, it is necessary to produce an electrode and to pass current, and a property deteriorates by alloy-ization of the electrode material under an elevated temperature before oxidation treatment by the method of acting as the monitor of the spontaneous-emission light shown in the above-mentioned conventional example. The method of the spontaneous-emission light monitor by optical pumping takes special equipment upwards, and observation is difficult.
[0006] Furthermore, the size of the non-oxidizing field used as a luminescence field will change in the size of an etching field, and since etching control highly precise in order to secure the homogeneity for every element is needed, the technique of wet etching [that it is simple and low cost] cannot be used for it. Moreover, since the required size of a non-oxidizing field is about several micrometers, dispersion in mum order which considers these as a cause turns into dispersion with big electric / optical property of an element, and appears.
[0007] Then, the purpose of this invention is to suppress dispersion in the element property resulting from dispersion in the size of such a current constriction field, and offer the low cost manufacture method of a field issue laser element.
[0008]
[Means for Solving the Problem] this invention person completed this invention, as a result of repeating various examination, in order to attain the above-mentioned purpose.
[0009] In the manufacture method of the surface emission-type laser which has the composition partially formed into high resistance by oxidation treatment so that, as for the 1st invention, the constriction of the inrush current to a barrier layer might be performed On a substrate, grow up a multilayer, prepare an oxidizing zone near [the] the barrier layer, and an antioxidizing layer is alternatively formed only in the luminescence field on the oxidizing zone. Oxidize the whole after that, only the amount of [of an oxidizing zone] outcrop is made to oxidize alternatively, and it is related with the manufacture method of the surface emission-type laser characterized by forming current constriction structure by subsequently growing up a multilayer.
[0010] The 2nd invention relates to the manufacture method of the surface emission-type laser the 1st invention which forms an oxidizing zone and an antioxidizing layer above a barrier layer so that the crystalline disorder of the barrier layer by the regrowth after formation of an oxidizing zone can be suppressed.
[0011] The 3rd invention relates to the 1st which performs oxidation treatment after formation of an oxidizing zone and an antioxidizing layer by carrying out a temperature up in the atmosphere, without exposing to a steam, or the manufacture method of the surface emission-type laser the 2nd invention.
[0012]
[Embodiments of the Invention] Hereafter, the gestalt of operation of this invention is mentioned and it explains in detail.
[0013] On a substrate, this invention grows up a multilayer, prepares oxidizing zones, such as AlAs, near [the] the barrier layer, oxidizes only the portion which grew up to be only a luminescence field on the oxidizing zone alternatively by the mask shutter method etc., and exposed antioxidizing layers, such as GaAs, by this at it in natural selection, and forms current constriction structure. After that, the remaining multilayer is grown up and an element is completed.
[0014] In that case, as for an oxidizing zone and an antioxidizing layer, arranging above a barrier layer is desirable so that the crystalline disorder of the barrier layer by the regrowth after formation of an oxidizing zone can be suppressed.
[0015] Moreover, as for a crystal growth and oxidation treatment, it is desirable to be based on the following method of having used MBE crystal-growth equipment. First, at a crystal-growth room, a multilayer, an oxidizing zone, and an antioxidizing layer are formed. Subsequently, the substrate is once moved to the enteroom where it connected with the crystal-growth room, the atmosphere is introduced there, the temperature up of the substrate itself is carried out to 400 degrees C, and oxidation treatment is performed. This substrate is again moved to a deposition chamber, and the remaining layers are formed.

[0016] By the method of forming the current constriction structure of this invention, in order not to carry out oxidization advance from the circumference of a multilayer and to oxidize the oxidizing zone used as a current constriction layer from right above, oxidization time decreases by leaps and bounds. Moreover, an oxidization field is strictly limited by the antioxidizing layer.
[0017] Consequently, change of the size of the non-oxidizing field for every element and reduction of element property dispersion accompanying this are attained. Moreover, time required for oxidization can be cut down sharply and the throughput of element production can be improved.
[0018] Moreover, in the composition of a surface emission-type laser, by arranging an oxidizing zone and an antioxidizing layer above a barrier layer, the crystalline disorder of the barrier layer by the regrowth after formation of an oxidizing zone can be suppressed, and degradation of optical properties, such as an oscillation threshold and efficiency, can be prevented.
[0019] Furthermore, since sufficient oxidization can be performed even if it does not introduce a steam in oxidation treatment, it is not necessary to take out a substrate from MBE growth equipment in a crystal-growth process, and a working stroke is shortened. Moreover, there is also no need for the special oxidation-treatment equipment which introduces a steam.
[0020]
[Example] Hereafter, although an example explains this invention further, this invention is not limited to these.
[0021] Example 1 drawing 1 is the abbreviation cross section of the multilayer of the surface emission-type laser of this invention.
[0022] The semiconductor multilayer was grown up by the molecular-beam beam epitaxy (MBE) method on the n+-GaAs substrate 1 of n type dope. n-GaAs and n-AlAs The bottom multilayer reflecting mirror 2 of n type dope of doping concentration 2x1018cm-3 which were made to carry out a laminating by turns and consisted of thickness of the quadrant of oscillation wavelength, respectively, and the In0.2Ga0.8As distortion quantum well layer of non doping the barrier layer 3 of 10nm of each thickness The interlayer 4 who consists of included aluminum0.2Ga0.75As. The oxidizing zone 5 which consists of p-AlAs of doping concentration 3x1018cm-3 by 30nm of thickness. The top multilayer reflecting mirror 6 of p type dope of doping concentration 3x1018cm-3 which were made to carry out the laminating of p-GaAs and p-AlAs by turns by the thickness of the quadrant of oscillation wavelength, respectively, and were constituted is formed. The antioxidizing layer 7 which consists of p-GaAs of doping concentration 3x1018cm-3 by 10nm of thickness is formed in the luminescence field with a diameter [of the non-oxidizing field (5a) upper part of an oxidizing zone] of 5 micrometers.
[[illegible]] Drawing 2 is an abbreviation cross section explaining the production process of the surface emission-type laser by the method of this invention.
[0024] First, on a substrate, as shown in drawing 2 (a), all the layers to the AlAs layer used as an oxidizing zone 5 are formed uniformly. Then, GaAs which carries out contiguity arrangement of the mask shutter which has the opening 10 with a diameter of 5 micrometers only in a luminescence field as shown in drawing 3 on the above-mentioned substrate, and serves as the antioxidizing layer 7 is grown up by the MBE method (drawing 2 (b)). Thereby, the antioxidizing layer 7 is alternatively formed only in a luminescence field.
[0025] A mask shutter is removed, the above-mentioned substrate is taken out from MBE crystal-growth equipment, and oxidation treatment is performed extensively next. It becomes possible to oxidize by this only the field which has not been covered with the antioxidizing layer 7 of an oxidizing zone 5 in natural selection (drawing 2 (b)).
[0026] Then, a substrate is again returned to an MBE room, surface cleaning processing is performed, and all the remaining layers are grown up (drawing 2 (c)).
[0027] Next, it left the field with a diameter [centering on a luminescence field] of 50 micrometers, etching removed to the upper part of the bottom multilayer reflecting mirror 2, and the p lateral electrode 8 was formed in the upper surface of the top multilayer reflecting mirror which formed and left the n lateral electrode 9 to the upper surface of a bottom multilayer reflecting mirror (drawing 2 (d)).
[0028] Outgoing radiation of the laser beam is carried out to a rear-face side through a substrate. The time out of which the thickness of an oxidizing zone comes enough by 30nm and which a certain shell and oxidization take becomes 1.5 seconds on the same oxidization conditions as the conventional example.
[0029] In the example 2 above-mentioned example 1, since the temperature up under the same steam atmosphere as usual performed the oxidation treatment itself, it once needed to take out the substrate from MBE crystal equipment. this example explains how to perform without introducing the steam of invention of the above 3rd.
[0030] Drawing 4 is outline structural drawing of the MBE growth equipment used for this example. First, after forming the layer to an oxidizing zone 5 and the antioxidizing layer 7 at the crystal-growth room 11, once, the move rail 13 is used for the anteroom 12 where this substrate 16 was connected with the crystal-growth room 11, and it moves to it. Let this anteroom 12 be a vacua so that the degree of vacuum of a d[illegible]sition chamber may not fall at the time of substrate movement.
[[illegible]] The connection valve 14 is closed after substrate movement, the atmosphere is introduced only into an anteroom 12 from an inlet 15, and the temperature up of the substrate itself is carried out to 400 degrees C. Although it is also possible at this time to introduce a steam like a conventional method, by the time it attains a degree of vacuum required of this in the case of re-movement in a crystal-growth room, it is **** about a long time. Moreover, since it is small 3 figures compared with 30nm and a conventional method, the depth required for oxidization does not need to introduce a steam purposely.
[0032] After the substrate 16 after oxidizing by this method vacuum-izes an anteroom 12 to a degree of vacuum of the same grade as the crystal-growth room 11, again. It uses the move rail 13 for the crystal-growth room 11, moves to it, and forms the remaining layers.
[0033] In the examples 1 and 2, although the example of a rear-face outgoing radiation type surface emission-type laser was shown, it is applicable also to the surface outgoing radiation type side luminescence laser which formed the point outgoing radiation aperture in p type electrode. Moreover, although the barrier layer 3 was set to In0.2Ga0.8As and the wavelength of a laser beam was set as 0.98-micrometer band, the same composition is applicable to other wavelength by changing the material of a barrier layer 3, and the material of the multilayer reflecting mirrors 2 and 6.
[0034]
[Effect of the Invention] Since control of an element property becomes easy according to this invention so that clearly from the above explanation, dispersion in the structure for every element can be reduced, and the homogeneity of an element property can be improved. Moreover, since time required for oxidization is sharply reducible, the throughput of element production improves, and a manufacturing cost decreases. Furthermore, since the monitor of a steam or the conventional spontaneous-emission light is not needed in oxidation treatment, it becomes a simpler process and much more low-cost-ization is attained.

[Translation done.]